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GROUNWATER IN THE

BX CREEK AREA

VERNON, BC

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GROUNDWATER IN THE BX CREEK AREA, VERNON, B.C.

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British Columbia Department of Mines

Victoria, B. C.

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GROUNDWATER IN THE BX CREEK AREA, VERNON, B.C.

Introduction

Most of the farmers in the BX Creek area depend upon wells for their domestic water supply. Seventeen wells north of BX Creek are reported to go dry in the winter months and no increase in water supply has resulted from attempts to deepen several of them. Many of the farmers affected have resorted to hauling water from nearby lakes during the dry periods but this has proved expensive and time consuming. The Water Rights Branch requested the writer to make a study of the groundwater in the BX Creek area and to assess the possibility of obtaining adequate domestic and farm water supplies in the critical area by deeper drilling.

The writer spent four days in the field compiling data on wells in an area extending from the Lumby Road on the south to about 3 miles north of BX Creek, and from the city of Vernon and the east side of Swan Lake to the uninhabited hills about 2 miles east of the city. Little useful information was obtained on many of the wells which had been dug many years ago.

Sources of Water in the Area

Five sources of water are relied upon by the fruit and stock farmers of the area for their domestic and farm requirements: precipitation, irrigation, springs, the city

water supply, and wells. These vary considerably in degree of importance within limited areas. The mean annual precipitation in the Vernon area from 1919 to 1950 was only 15.7 inches and consequently the fruit farmers depend upon irrigation for the maintenance of their orchards. Irrigation water is mainly supplied by a flume which extends along the hillside on the eastern side of the area and which operates for four summer months. Natural springs, issuing from fractured bedrock, supply several farms with water for domestic use, for watering cattle, and, in a few cases, for limited irrigation in the eastern part of the area south of BX Creek. Relatively small areas both north and south of BX Creek are supplied with city water. These are outlined on the accompanying topographic plan.

Dug and drilled wells are the most important source of water for domestic use in the area and many farmers also rely upon them for the watering of stock and some irrigation. Most of the wells have been dug by hand and many are concrete lined and covered with a heavy concrete lid. Some farmers have installed automatic pumping systems but many still draw water by hand.

General Geology

The BX Creek area is gently undulating farmland rising from the Kalamalka-Swan Lake flats at approximate elevation 1,280 feet to the rocky hillsides about 2 miles east of Vernon. Most of the cultivated land lies at elevations between 1,400

and 1,700 feet. BX Creek flows southwesterly and westerly in a narrow gravel gorge about 80 feet deep near the centre of the area. Several small, intermittent, westward draining creeks traverse the farmland especially in the extreme northern part of the area.

The superifical deposits of the area have been mapped by H. W. Nasmith[1] and a portion of his Winfield-Enderby map accompanies this report (Fig. 1). The bedrock geology of the area has been mapped by Rice and Jones.[2] The farmland occupying most of the area south of BX Creek and the flats bordering the east side of Swan Lake are underlain by fine-grained glacial lake sediments deposited during the waning of the last glacier to occupy this area. These sediments consist of interstratified beds ranging in composition from clay to sand with a preponderance of silty sand and sandy silt. Gravel lenses occur locally. Coarse, locally stratified sandy gravels form irregular terraces along the eastern margin of the area both north and south of BX Creek and, in part, lie directly upon bedrock. These gravels are believed to have been deposited as kame terraces along the margin of the last glacier. Alluvial fans and deltas formed during the retreat of the last glacier, and in post-glacial time, border and underlie BX Creek and underlie the extreme western margin of the area. These deposits

[1]Nasmith, H.W.: B. C. Department of Mines unpublished report.
[2]Rice, H.M.A. and A.G. Jones (1948): Salmon Arm Map-Area, Geological Society of Canada, Preliminary Paper 48-4.

are predominantly sandy gravel in composition.

Much of the central part of the area north of BX Creek has been mapped as being underlain by ice-compacted sediments deposited prior to the last advance of glacial ice. The maximum depth of this glacial advance material is probably over 200 feet. Where encountered in water wells it appears to range widely in composition and lithology even within small areas, although very permeable gravels appear to predominate. Late glacial and post-glacial sediments form a thin intermittent veneer over these deposits.

The bedrock outcropping in the northern and eastern parts of the area has been mapped as schists and gneisses of the Lower Palaeozoic (?) Larkin formation and basic volcanics of the Carboniferous (?) and Permian Cache Creek Group. Fractures and fissures in these rocks form the channelways for much of the water entering the unconsolidated aquifers of the area.

Groundwater in the Area Between Lumby Road and BX Creek

For convenience, the area has been divided into two sections, one extending from the Lumby Road to BX Creek and the other from BX Creek to about 3 miles north of the creek.

In the area south of BX Creek eighty wells were examined, and their locations are plotted on the accompanying topographic plan. Brief notes on individual wells are included in the appendix. Sixty-three wells ranging in depth from 6 feet

to 100 feet and averaging about 30 feet have been dug into the glacial lake sediments in this area. With the exception of wells 55 and 56 which are reported to have been dug into hard blue clay possibly representing till overlying bedrock, and a few wells dug into gravel lenses, the wells in this area appear to draw their water from highly permeable and laterally continuous silty sand members. Clay interbeds were apparently encountered in many wells indicating that some water enters the wells from perched water tables. Water levels in early August, 1959 ranged from -2 feet to -70 feet and averaged about -15 feet. Seasonal water level fluctuations in individual wells are reported to be relatively minor and year round pumping of several of them to water small herds of cattle was unable to pump these wells dry.

A series of springs issuing from fractures in bedrock occurs along the rocky hillside on the eastern margin of the area. Apparently these springs flow without any appreciable seasonal variation and a single spring often supplies several properties with domestic and farm water. Although the farms in this eastern section derive most of their water from springs, six wells have been dug into the kame terrace gravels. The water level in these wells in early August, 1959 ranged from -5 feet to -15 feet and there is reported to be little seasonal variation in these levels. Also, near the Lumby Road three wells (about 2,000 feet east of a spring) have been dug into

stratified gravels mapped as glacial advance material. This material forms a ridge which encircles the 2,000 feet high rocky hill immediately south of the road. The water table in these wells is near the ground surface and the wells are reported to give a year-round water supply sufficient for domestic and farm requirements.

In summary, there seems to be no immediate groundwater shortage in this area. A high percentage of the water supplying the unconsolidated aquifers is conducted to the area through fractures and fissures in the underlying bedrock. Normal precipitation and irrigation seepage also contribute to the groundwater reservoir but appear to be of considerably less importance. The ultimate source of the water in the fractured bedrock is probably the wooded mountainous area to the east.

Groundwater in the Area North of BX Creek

In the area north of BX Creek eighty-five wells were examined, and their locations are plotted on the accompanying topographic plan. Brief notes on individual wells are included in the appendix. On the accompanying plan an irregular northeast trending strip is outlined. This lies largely within the area of ice-compacted sediments. The southwest tip of the outlined area falls within an area mapped as a raised delta of BX Creek. Twenty-four wells ranging in depth from 25 feet to 135 feet and averaging approximately 76 feet have been dug

or drilled into these sediments. A few of these wells have been dry all year for the past several years, and many have gone dry in the winter months. Only a few are reported to give a limited domestic water supply all year. To the east and northeast of the outlined area several shallow wells in the highly permeable kame terrace gravels are reported to give an adequate domestic water supply all year. Water levels in these wells in August, 1959 averaged only -7 feet. Downhill, to the west of the outlined area, ten wells ranging in depth from 6 feet to 40 feet have been dug into highly permeable sands and gravels and the water levels in these wells in August, 1959 averaged approximately -17 feet. The owners reported that these wells gave an adequate domestic water supply all year.

It appears that the relatively shallow wells surrounding the outlined area obtain water from perched water tables. These water tables are related to underlying, discontinuous, lenticular masses of impervious sediments lying within permeable sands and gravels. Well 104A, which is a drilled well, was collared in one of these impervious masses which outcrops in that area and is about 20 feet thick. A greatly simplified diagrammatic cross-section illustrating the mechanism of the groundwater movement within and near the outlined area is shown in Figure 2. To the east and northeast, above the outlined area, water from irrigation

seepage, normal precipitation, and possibly from fractures in the underlying bedrock enters the perched aquifer and travels westward. The irrigation seepage appears to be the most important water source for this aquifer during the summer months, because the water levels in the wells are reported to fluctuate considerably with the amount of irrigating being done. The underlying impervious lenses do not extend into the outlined area and consequently the perched water, upon reaching the western limit of the impervious lenses, percolates downward to an underlying main water table at an unknown depth. However, a small amount of this water finds its way into the outlined area and supplies some of the wells with a limited quantity for short periods in the summer months. To the west, that is, downhill from the outlined area, irrigation seepage and precipitation supplies other perched aquifers with water, and the nature of the groundwater movement in that area is much the same as it is to the east.

It appears that the main water table has not been encountered in any of the wells in the outlined area or in the area immediately around it. However, its maximum depth will not be below 1,276 feet which is the approximate elevation of Swan Lake and it will probably be somewhat higher. The main water table would eventually be encountered by deepening any of the wells within the outlined area but it is impossible to predict the depth necessary to accomplish this and the nature

of the material underlying this water table.

A local driller who employs a cable tool rig in drilling for water in this area quoted the writer $11.50 per foot for a 6-inch diameter hole including the casing and $9.50 per foot for a 4-inch diameter hole including the casing. These prices are considered reasonable. It is the writer's opinion that in drilling with a cable tool rig to the depths required in this area there would be a reasonable chance of losing the hole before the main water table was encountered. However, this could be largely overcome by collaring the holes in already existing wells.

Pumping costs to raise water to the ground surface from deep wells, and costs of distributing the water throughout the area, would also have to be taken into consideration in assessing the feasibility of supplying this area with water from this source. This is assuming that a limited number of wells can be demonstrated to provide an adequate water supply to the outlined area.

APPENDIX

WATER WELLS, BX CREEK AREA, VERNON, B.C.

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
1	30	18	Water level approximately constant all year. Silty sand.
2	-	11	" " " " " " " "
3	-	11	" " " " " " " "
4	-	20	" " " " " " " "
5	-	20	" " " " " " " "
6	-	20	" " " " " " " "
7	-	10	" " " " " " " "
8	-	-	Adequate domestic supply all year. Silty sand.
9	-	8	" " " " " " "
10	-	4	" " " " " " "
11	-	10	" " " " " " "
12	-	11	" " " " " " "
13	-	10	" " " " " " "
14	-	10	" " " " " " "
15	-	4	" " " " " " "
16	-	20	" " " " " " "
17	30	10	" " " " " " "

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
18	28	12	Adequate domestic supply all year. Silty sand.
19	30	12	" " " " " " "
20	31	12	" " " " " " "
21	-	10 - 15	" " " " " Gravel.
22	-	10 - 15	" " " " " "
23	-	10 - 15	" " " " " "
24	-	12	" " " " " Silty sand.
25	-	8	" " " " " " "
26	-	5	" " " " " " "
27	-	5	" " " " " " "
28	-	5	" " " " " " "
29	-	5	" " " " " " "
30	-	3	" " " " " Gravel.
31	-	surface	" " " " " "
32	-	"	" " " " " "
33	100	50	" " " " "
34	-	20	" " " " "
35	70	60	" " " " " but insufficient for stock. Water-bearing gravel bed 5 feet thick.

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
36	21	16	Adequate domestic supply all year.
37	-	15	" " " " "
38	20	10 - 15	" " " " "
39	-	15	" " " " "
40	-	7	" " " " "
41	48	40	Adequate domestic and cattle supply.
42	59	46	" " " " "
43	13	7	Adequate domestic supply all year.
44	30	13	" " " " "
45	27	24	Occasionally goes dry.
46	24	20	Adequate domestic supply all year.
47	37	35½	" " " " "
48	13	7	" " " " "
49	19	8	" " " " "
50	13	5	" " " " "
51	42	30	" " " " "
52	32	-	Abandoned.
53	17	9	Adequate domestic supply all year.
54	17	9	" " " " "

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
55	50	45	Goes dry in winter. Clays.
56	50	45	" " " " "
57	40 - 50	30	Adequate domestic supply all year.
58	22	10	Used little.
59	75 - 80	70?	Adequate domestic supply all year.
60	12	-	" " " " "
61	32	10?	" " " " "
62	10	5	" " " " "
63	10	5	" " " " "
64	-	-	
65	16	8	" " " " "
66	22	10	" " " " " 0' - 20' : clayey sand 20' - 21' : gravel 21' - 22' : bedrock
67	56	40	" " " " "
68	-	15	Went dry winter, 1959.
69	6	2	Adequate domestic supply all year.
70	-	-	" " " " "
71	13 - 16	6	" " " " "
72	-	8	" " " " "

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
73	-	4	Adequate domestic supply all year.
74	-	15	" " " " "
75	52½	40	" " " " " Gravel.
76			Spring.
77	12	8	Adequate domestic supply all year.
78	32	24	Occasionally dry in winter.
79	25	20	" " " "
80	30	-	" " " "
81	6 - 9	2	Adequate domestic supply all year.
82	6 - 9	2	" " " " "
83	35	30	" " " " "
84	18	9	" " " " "
85	15	5	" " " " "
86	-	-	" " " " "
87	12	3	" " " " "
88	21	10	" " " " "
89	20	10	" " " " "
90	20	10	" " " " "
91	20	4	" " " " "

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
92	37	20	Adequate domestic supply all year.
93	42	17	Occasionally runs dry but generally adequate supply all year.
94	12	-	Adequate domestic supply all year. 0' - 9' : gravel 9' - 12' : hardpan
95	-	10	" " " " "
96	-	-	Being dug, August 1959.
97	25	19	Adequate domestic supply all year.
98	60	20	" " " " "
99	27	19	" " " " "
100	27	19	" " " " "
101	65	60	" " " " "
102	112	62	Occasionally goes dry.
103	65	60	Goes dry in winter.
104A	98	88	Barely sufficient domestic supply all year. Drilled well : 4-inch casing. 0' - 20' : clay 20' - 30' : gravel 30' - ? : silt Gravel at bottom water-bearing.
104B	46	-	Dry. 0' - 21' : clay 21' - 21½' : sand 21½' - 46' : gravel
105	25	-	Goes dry in winter. (Water-bearing horizon at -18 feet.)

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
106	13	8	Adequate domestic supply all year.
107	28	-	" " " " " (?)
108	18	8?	" " " " " (Silty sand at -14 feet water-bearing.)
109	-	-	" " " " "
110	-	-	
111	30	16	" " " " "
112	45	-	" " " " "
113	60	-	Goes dry in winter. Hardpan.
114	not deep	-	Usually adequate supply.
115	96	95	Goes dry in winter.
116	104	-	Barely sufficient for household use.
117	124	-	Dry since autumn, 1958.
118	135	130	Barely sufficient for household use.
119	-	9	Newly dug pit.
120	65	-	Dry. 0' - 65' : gravel
121	85	-	Dry. 0' - 85' : gravel
122	100	-	Dry. 0' - 100' : gravel
123	19	3	Barely sufficient for household use.

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
124	43	-	Dry from January to irrigation season. (4-inch pipe) 0' - 43' : gravel
125	97	-	Dry in winter.
126	shallow	-	Adequate domestic supply only.
127	18	12 - 13	Sometimes low but never dry.
128	14	10?	Adequate domestic supply all year.
129	27	9	" " " " "
130	20	-	Dry.
131	30?	8	Barely sufficient for household use. Has been pump dry.
132	-	10	" " " " "
133	40	8	Adequate domestic supply all year. Reported to yield 600 gal./hr. 0' - 40' : gravel
134	60	-	Dry in winter.
135	16	-	Adequate domestic supply all year.
136	-	6	" " " " "
137	6	4	Ran dry twice but generally adequate domestic supply.
138	6	1	Adequate domestic supply all year.
139	24	-	" " " " "
140	12	5	" " " " "
141	48	8	Mostly in rock. (6-inch casing) Adequate domestic supply.

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
142	-	-	Adequate domestic supply all year.
143	23	10	" " " " "
144	23	10	" " " " " 0' - 15' : ? 15' - 23' : sand 23' : hardpan
145	23	10	" " " " "
146	18	3	" " " " "
147	25	4	" " " " "
148	6	-	" " " " " (spring nearby)
149	8	-	" " " " "
150	8	-	" " " " "
151	15	-	Dry. (Being dug August, 1959.) Brown clay.
152	38	20	Adequate domestic supply all year.
153	40	30	" " " " " (Water-bearing horizon is sand.)
154	48 - 58	-	Dry.
155	19	10	Adequate domestic supply all year.
156	10	5	" " " " "
157	8	-	" " " " "
158	6	surface	" " " " " (Water-bearing horizon is sand.)
159	38	27	" " " " "

Well No.	Depth (ft.)	Approximate Depth to Water (ft.) (Aug., 1959)	Remarks
160	38	27	Adequate domestic supply all year.
161	22	-	" " " " "
162	140		Dry. Near packing plant on east side of Swan Lake. 0' - 140' : impervious clay
163	58	$55\frac{1}{3}$	Adequate domestic supply all year. 0' - 58' : gravel
164	-	-	" " " " "
165	-	15	Dry.

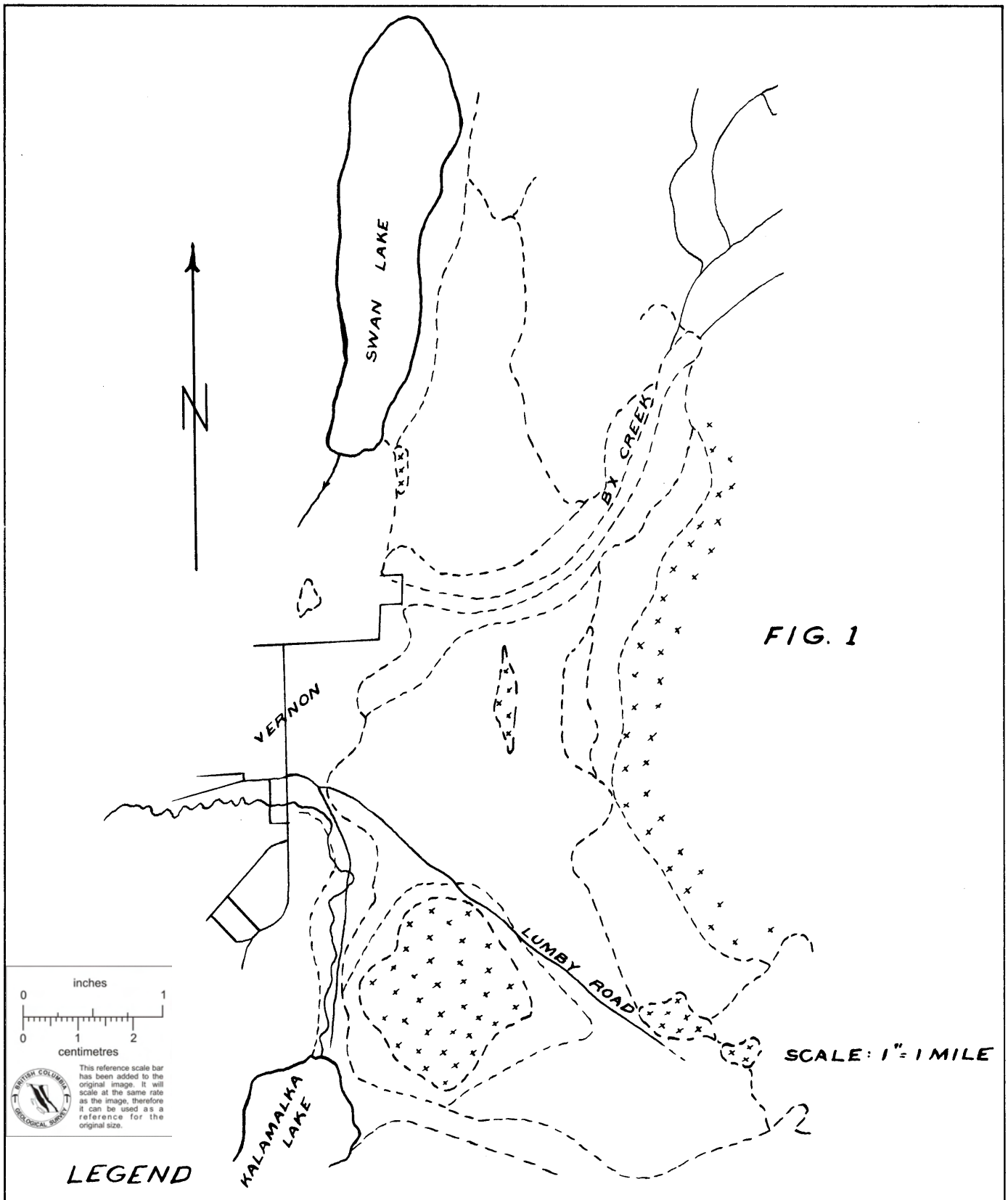

FIG. 1

inches
0 1
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centimetres

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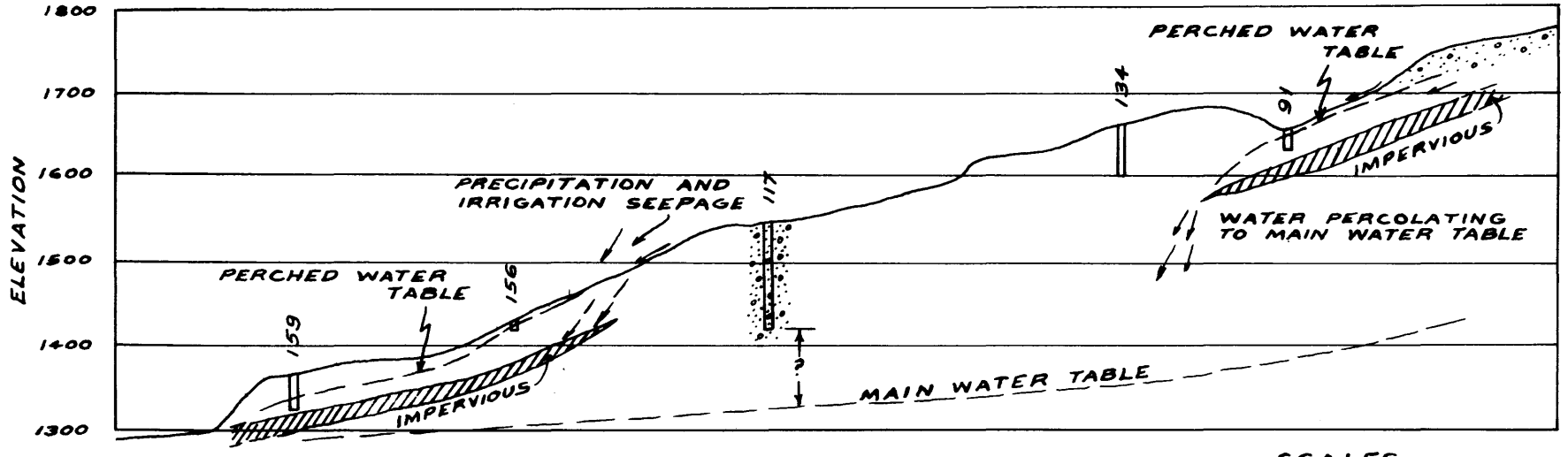
LEGEND

- FANS, DELTAS (MAINLY GRAVEL)
- KAME TERRACES (" ")
- DELTAS, FANS, TERRACES (MAINLY GRAVEL)
- GLACIAL LAKE SEDIMENTS (SAND, SILT & CLAY)
- ICE COMPACTED SEDIMENTS (MAINLY GRAVEL)
- BEDROCK

GEOLOGY OF BX CREEK AREA, VERNON, B.C.

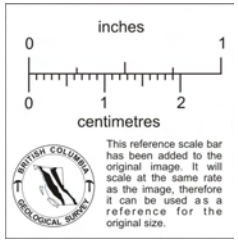
-AFTER H. NASMITH-

SECTION A-B



SCALES:
HORIZ: 1"=1000'
VERT: 1"=200'

FIG. 2



LAKE

SWAN

B.X. Creek

B.X. Creek

B.X. Creek

NORTH

AREA OF DRY AND OCCASIONALLY DRY WELLS

AREA SUPPLIED BY CITY WATER

AREA SUPPLIED BY CITY WATER

City Boundary

VERNON

SPRING

SPRING

SPRING

SPRING

SPRING

SPRING

SPRING

SPRING

SPRING

inches
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0 1 2 3 4 5
centimetres

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BRITISH COLUMBIA
DEPARTMENT OF MINES

PLAN OF B.X. CREEK AREA SHOWING LOCATION OF WATER WELLS

TO ACCOMPANY REPORT ENTITLED
"GROUNDWATER IN THE B.X. CR. AREA, VERNON, B.C."

SCALE : 1 IN. = 1000 FT.